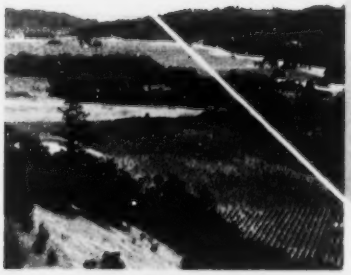
SEPTEMBER 24, 1990
CHEMICAL & ENGINEERING

Candidates in ACS fall election: Their views and backgrounds
Page 28

NEWS

California



Initiative would require stringent environmental regulation
Page 7

CHEMICAL & ENGINEERING
NEWS
SEPTEMBER 24, 1990

Volume 68, Number 39
CENEAR 68 (39) 1–56
ISSN 0009-2347

News of the Week

■ **Bush Administration chooses Walter Massey of the University of Chicago to fill NSF directorship and may offer NIH top position to Bernadine Healy of the Cleveland Clinic.** Page 4

■ **Forecast for 1990 chemical capital spending is revised downward in the latest Commerce Department survey.** Page 5

■ **Researchers discover way to genetically modify defective cystic fibrosis cells and so open opportunity for future gene therapy.** Page 5

■ **EPA Administrator William Reilly outlines action on Clean Air Act and new environment initiative, and praises voluntary toxic air emissions cuts by industry.** Page 6

Business

New markets are opening up for commercial enzymes, including animal feed additives, bleaching of pulp, and "biostoning" of denim garments. **Page 17**

Program for certification of chemical workers to improve their performance, safety in jobs that could affect public has been launched by the Synthetic Organic Chemical Manufacturers Association. **Page 19**

Government

Critics are asking hard questions about NASA's Mission to Planet Earth, an ambitious program aimed at understanding Earth as an integrated system. **Page 21**

Federal agencies are competing well in the marketplace for the services of scientists and engineers, a recent study finds. **Page 23**

Science/Technology

Strategy for systematic synthesis of linear and branched oligosiloxanes devised by team of chemists in U.S. and Japan. **Page 25**

New chemical software includes new entries in chemical research information management, molecular modeling. **Page 26**

ACS Election

Candidates for 1991 president-elect, directors-at-large, and directors for regions III and VI present views on ACS and its programs. **Page 28**

Letters 2

Concentrates

Business 15
Government 20
Science/Technology 24

The Departments

ACS News 44
Newscripts 56

News Focus

Four initiatives facing voters in California propose confusing array of environmentally oriented controls for climate, agriculture, timber, and oil issues. Page 7

Chemical & Engineering News
1155—16th St., N.W., Washington, D.C. 20036
Editor: Michael Heylin
Assistant Managing Editors: David M. Kiefer, James H. Krieger, Janice R. Long, Donald J. Soisson, William J. Storck. **News Editor:** Wilbert C. Lepkowski
Staff Editor: Ernest L. Carpenter
Senior Editors: New York: Earl V. Anderson, Stephen C. Stinson; Chicago: Joseph Haggin; London: Patricia L. Layman; Washington: Doron Dagani, Lois R. Ember, Bette Hileman, Rebecca L. Rawls, Pamela S. Zurer
Associate Editors: Stuart A. Borman, Mairin B. Brennan, Ann Marie Menting, Richard J. Seltzer
Service Departments Editor: Dolores Miner
Editing Services: Anne Riesberg (Head); Arlene Goldberg-Gist (Editorial Assistant); Patricia Oates (Administrative Assistant)
News Bureaus: Northeast News Bureau: (201) 906-8300 Marc S. Reisch (Associate Editor); Ann M. Thayer (Associate Editor); Rachel Eskenazi (Administrative Assistant). Chicago: (708) 256-4143 Ward Worthy (Head). Houston: (713) 973-8161 Bruce F. Greek (Head); Susan J. Ainsworth (Associate Editor). Washington: (202) 872-4495 David J. Hanson (Head). West Coast: (415) 653-3630 Rudy M. Baum (Head). **Foreign Bureau:** London: (01) 540-0414 Dermot A. O'Sullivan (Head)
Graphics and Production: Leroy Corcoran (Head); Alan Kahan (Art Director); Barbara Fryer (Production/Art Director); Linda Mattingly (Staff Artist); Diane Kelly (Costing)
Business Manager: Arthur Poulos
Circulation Director: David Schulbaum
ADVISORY BOARD: Dexter F. Baker, George M. Bodner, Will D. Carpenter, Renée G. Ford, Ethan C. Galloway, Louis J. Glunz, Harry S. Hertz, Christopher T. Hill, Kendall N. Houk, Cynthia A. Maryanoff, Linda B. McGown, C. Bradley Moore, Koji Nakanishi, George B. Rathmann, David A. Shirley, Robert M. Simon, Peter H. Spitz, Barry M. Trost
Published by
AMERICAN CHEMICAL SOCIETY
(202) 872-4600; TDD (202) 872-8733
John K. Crum, Executive Director
Robert H. Marks, Director, Publications Division
PUBLISHING BOARD: Jeanne M. Shreeve (*Chairman*); *Board of Directors Chairman*: Joseph A. Dixon; *President*: Paul G. Gassman; Richard L. Deming, William P. Jencks, Gary J. Long, and Louis D. Quin

© Copyright 1990, American Chemical Society

Subscription & Member Record Service: Send all new and renewal subscriptions with payments to: ACS, Dept. L-0011, Columbus, Ohio 43268-0011. Correspondence and telephone calls for changes of address, claims for missing issues, subscription orders, status of records and accounts should be directed to: Manager, Member & Subscriber Services, ACS, P.O. Box 3337, Columbus, Ohio 43210; (800) 333-9511 or (614) 447-3776.

For changes of address, include both old and new addresses with ZIP code numbers and mailing label from a recent issue. Allow four weeks for change to become effective. Claims for missing numbers will not be allowed if loss was due to failure of notice of change of address to be received in the time specified; if claim is dated (a) North America: more than 90 days beyond issue date, (b) all other foreign: more than one year beyond issue date, or if the reason given is "missing from files."

Subscription Rates 1990. Printed editions: nonmembers U.S. 1 yr. $60, 2 yr. $108, outside U.S. 1 yr. $93, 2 yr. $174. Air freight rates available on request. Rates above do not apply to nonmember subscribers in Japan, who must enter subscription orders with Maruzen Co. Ltd., 3-10 Nihonbashi 2-chome, Chuo-ku, Tokyo 103, Japan. Tel. (03) 272-7211. Single copies: Current $9.00. Rates for back issues and volumes are available from Microforms & Back Issues Office, ACS, 1155—16th St., N.W., Washington, D.C. 20036. Back and current issues available on microfilm and microfiche. Rates on request from Microform Program, ACS.

Chemical & Engineering News (ISSN 0009-2347) is published weekly except for the last week in December by the American Chemical Society at 1155—16th St., N.W., Washington, D.C. 20036. Second-class postage paid at Washington, D.C., and additional mailing offices. POSTMASTER: Send address changes to Chemical & Engineering News, Membership & Subscription Services, P.O. Box 3337, Columbus, Ohio 43210. ACS assumes no responsibility for the statements and opinions advanced by the contributors to its publications.

Advertising Management
CENTCOM LTD.
(For list of offices see page 55)

LETTERS

Biomass burning

Your "News of the Week" article (C&EN, March 26, page 4) claims that the environment is hurt more than thought by biomass burning.

This view arose from the atmospheric sciences' attempting to model the fate of fire-released gases in the environment. The conclusion reached may be wrong.

Many plants are serotinous; that is, their seeds are opened and released only by fire. Indeed, some 90,000 hectares of southwestern Africa possess a unique biome of some 8000 species, known as "fynbos," which relies almost totally on fire for its propagation. Far from hurting the environment, fire is an essential component.

William H. Romme and Don G. Despain [*Sci. Am.*, **261**, 36 (1989)] document the effects of burning Yellowstone in 1988. Massive fires every 150 years or so are part of the natural succession of the woodlands, not only propagating serotinous species but also releasing a range of essential nutrients. Indeed, evidence is accumulating that the alkaline ash generated in fires is an essential component in neutralizing acidity generated in leaf decay, particularly in conifer forests, and may help to protect woodlands against acid rain.

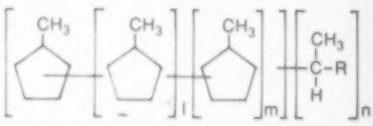
Although I am sure there is merit in being concerned about the buildup of carbon dioxide in the atmosphere, I am also concerned that dramatic headlines such as your own may cause precipitate action against biomass burning and result in more harm to the environment than good. The atmospheric modelers must take into account the essential natural contribution of fire.

Philip J. Lloyd
Industrial & Petrochemical Consultants, Ravenmoor
South Africa

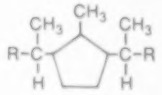
Alkylated cyclopentanes

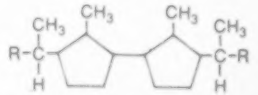
Please refer to Joseph Haggin's comments (C&EN, May 2, page 60) on a "new class of synthetic lubricants for extreme service conditions"—the alkylated cyclopentanes, presented recently by two chemists of Pennzoil Products Co. at the ACS national meeting in Boston.

The synthesis and the good properties of the alkylated cyclopentane oils were discovered in my laboratory in 1957 at the Research Department of Imperial Oil Ltd., Sarnia, Ontario. This invention is demonstrated in my patents: U.S. No. 3,000,981 and Canadian No. 655,942. The synthesis consists of alkylating monochlorinated methylcyclopentane with *n*-1-olefins in the presence of a Friedel-Crafts catalyst followed by hydrogenation over nickel to remove chlorine. The resultant oil was obtained in good yield and had good viscometric properties and low-temperature fluidity. For example, alkylation with *n*-1-decene gave an oil having a viscosity index of 131, a viscosity of 5.64 centistokes at 98.9 °C, and a pour point of -57 °C. The synthesis is very diversified, due to the numerous parameters involved, so that the following general formula was envisaged based on NMR data



where l, m, n are integers and R is a linear saturated hydrocarbon chain having a number of carbon atoms equal to that of the *n*-1-olefin used minus two. The following shows an example of two of the several structures obtained by this process:





I should mention that my work on this subject was triggered by the American Petroleum Institute reports on good viscometric and low-temperature properties of certain pure hydrocarbon compounds incorporating cyclopentane.

Dimitrios V. Favis
Beaconsfield, Quebec

Correction

• Aug. 27, page 17: The man pictured is Robert M. White, National Academy of Engineering president, not Robert M. White, Commerce undersecretary for technology, quoted in the story.

Promising New Markets Emerging For Commercial Enzymes

Potential uses for enzymes, whose growth has slowed recently, include animal feed additive, pulp bleaching, "biostoning" of denim

Detergents, dairy processing, and starch conversion: the classic major markets for enzymes. But new applications opening up, and other potential uses, are expanding the field for commercial enzymes beyond those traditional applications. The keys to some of the newest uses of enzymes: gentle biological action to replace rough mechanical action, in at least one new area, and more broadly, the capabilities to alleviate some environmental problems.

Those are among the conclusions of a new study of the $650 million enzymes business by London-based consultants L. Hepner & Associates. The study focuses on some 21 enzymes of industrial importance, which Leo Hepner and his colleague Celia Male define as those materials accounting for minimum annual sales of $1 million, in an industry that has been growing at about 10% per year. But it is also an industry that has slowed and that promises only basic growth of 3 to 4% per year over the next five years.

The enzyme-using markets were also examined: the traditional markets of detergents, starch conversion, and dairy, which together consume about 80% of all industrial enzymes, both merchant and captive, and a raft of smaller uses. These smaller uses cover a variety of industries, such as beverages; textile and leather treatments; food applications; animal feeds and silage; antibiotics and amino acids; and paper and pulp processing. Each of these uses currently accounts for anywhere from $1 million up to $30 million. The consultants also picked out promising new applications, including expanded uses in animal feed and in pulp and paper processing.

For some applications that might be suitable for enzymes, there is an appropriate material available, but at an inordinate price. That brings Hepner and Male to another focus of their study, improved technological capabilities in biotechnology, including protein engineering and recombinant technology.

Four years ago, according to the study, such work was still an academic exercise. However, there are now commercial products. A case in point is chymosin, a replacement for microbial rennin, in turn a replacement for calf rennin for cheese.

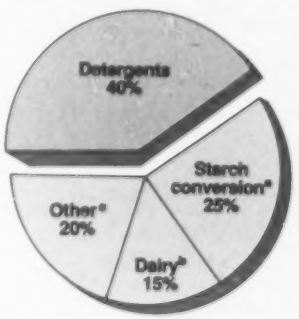
One of the most novel applications the study identified is for phytase as an animal feed additive. Phytin in grain binds phosphate, needed for bone development, in the feed. The feed formulator must dose the grain with additional phosphate so enough is available to the growing animal. An excess passes through in the animal's excrement, contributing to phosphate pollution in water. However, if a formulator pretreats feeds with phytase, the bound phosphate is released for metabolization. That dramatically reduces the need for additional phosphate dosing, and, in turn, lessens the pollution problem.

Enzymes stand to find a market solving yet another environmental problem, say the consultants, in bleaching of pulp. In the pulping process, cellulose is pretreated with calcium sulfite to digest wood chips. But lignin is left in the fiber; for bright white paper, bleaching is necessary. Lignin is shielded with a hemicellulose coating, so an excess of chlorine must be used for bleaching. However, if the hemicellulose is removed with cellulase or hemicellulase, the chlorine needed can be significantly reduced, thus lowering its presence in effluent.

A number of paper mills are now running trials, but chlorine is cheap, and cellulase would have to cost less than $5.00 per ton of pulp, without subsidies, to be competitive. However, the potential for this application is huge: There are some 50 million metric tons of bleached pulp made worldwide each year.

In a more fashion-conscious application, a cellulase formulation has been introduced for "biostoning," to vie with mechanical stone-washing of denim garments. In the U.S., about 50% of denim garments are stone-washed; in Western Europe, 70%. Pumice is typically used, added into industrial laundry machines with jeans, to rub against the fabric and remove some of the dye. But too

Detergents continue to dominate enzyme markets



1989 sales = $650 million

a Glucose, ethanol, and high-fructose corn syrups. b Rennin and others. c Includes fruit juice and other beverages; baking and flour; food additives; textiles and leather; and pulp and paper. **Source:** L. Hepner & Associates

much abrasion can damage the fabric. "Biostoning" features enzymes rather than pumice. According to Danish producer Novo Nordisk, the largest enzyme supplier worldwide, a cupful of enzyme could replace 100 times its weight in pumice stones.

Ironically, the development of cellulase markets points out one of the problems attendant to the enzymes industry: commodity versus specialty. The trick is to tailor enzymes for specific customer needs, a demand that is slowly leading to a decline in the number of suppliers. Small to medium-size companies are being snapped up by larger ones, as the market consolidates.

The number of major producers is now down to about 10, led by Novo Nordisk. Others include Gist Brocades, of the Netherlands; the Gist Brocades-Shell joint venture, IBIS; Cultor, formerly Finnish Sugar Co.; and Cultor's joint venture with Eastman Kodak, Genencor International.

Earlier this year Solvay bought part of the enzymes business of Bayer's Miles subsidiary to add to its Kali Chemie enzymes business. Another part of the Miles operations went to Rhône-Poulenc, now number two in dairy enzymes (Denmark's Hansen is number one). Other major enzyme makers are Unilever's Quest unit, which bought Biocon Biochemicals, a small Irish producer of brewing enzymes, and Sturge, with the citric acid and enzymes it acquired from RTZ, which recently shed its chemical operations.

The captive market currently accounts for 10% of enzyme consumption, led by Archer Daniels Midland of the U.S., for starch conversion for high-fructose corn syrup, and Henkel of West Germany for detergent proteases.

Detergent enzymes are also of particular interest for Japanese producers. The Japanese supply a market worth from $50 million to $60 million and that has probably doubled over the past four years, the study estimates. Part of the market is accounted for by traditional enzymes, for uses such as starch conversion and proteases.

Other, more unusual enzymes find applications in the Japanese market, too. For example, Japanese detergent producers use a cellulase in their no-builder concentrated detergent. And development is also being done on amylase, for formulating into dishwashing detergents as starch solubilizers.

The growth rate of the enzyme industry has been 10% per year over the past few years, but falling prices have brought an end to those days, the study says. Instead, it assumes a basic growth rate of 3 to 4% per year for the traditional markets over the next five years.

If some of the potential uses materialize, such as proteases penetrating further into the detergent market, or recombinant chymosin replacing microbial rennin, or phytase being used as a feed additive, total sales could rise more rapidly. Moreover, the market for cellulases and hemicellulases for pulp and paper could hit $200 million in five to 10 years, the study predicts.

"If all these things happen, growth could be 12% per year, taking the business to $1 billion by 1995," Hepner points out. However, Male cautions, "Some of these markets may not materialize: The enzymes may be too expensive, there may be a backlash against genetically engineered enzymes, and so on. Then the base growth of 3 to 4% per year will bring sales to about $750 million by five years."

The study also predicts that small enzyme producers, those with sales of less than $10 million per year, probably are not viable. Smaller companies, Hepner believes, cannot afford the time it takes—often 10 years—to develop a new market, such as that for cellulase. A producer could find a specific niche, he concedes, but "would still have to have the resources to make the enzymes, or to market them." Possible solutions might include a link with a producer who could make the enzymes for the company, or a link with a consortium of customers—several pulp makers, for example.

Patricia Layman

Organic Intermediates through Ishihara Sangyo's Advanced Technology:

NEW LUTIDINE DERIVATIVES

ISHIHARA SANGYO has added the above new compounds to its product line. Although these new developmental compounds are only in the research stage, small samples can be prepared for research and development purposes. We wish to make the best use of our processes to assist in the synthesis of your products.

ISK

ISHIHARA SANGYO KAISHA, LTD.
10-30, Fujimi 2-Chome, Chiyoda-ku, Tokyo, Japan. Telex 2324306 ISK J

ISK (EUROPE) S.A. ITT Tower 480, Avenue Louise Box 12A 1050 Brussels
Tel (02)646-3490 Fax (02)648-3472 Telex 23352 ISK(E) B

ISHIHARA CORPORATION (U.S.A.) Transamerica Pyramid 42nd Floor 600 Montgomery Street, San Francisco, Ca 94111
Tel 415-421-8207 Telex 278010 ICUSA UR